



mHealth and Malnutrition: Mobile Application Specifications

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Overview

Malnutrition is a largely unseen and rapidly growing health crisis both in the United States and globally. Estimates have suggested that as many 33 – 50 % of hospitalized patients suffer from malnutrition. Yet despite the pervasiveness of this issue, healthcare providers fail to successfully diagnose such patients, with less than 5% of malnourished patients accurately diagnosed. A number of severe complications and outcomes are associated with malnutrition, including a 200% greater likelihood for wound breakdown or pressure ulcer, a 300% increased chance for surgical site infection, increased susceptibility to illness, risks for falls, prolonged stays in rehabilitation facilities, 70% longer hospital stay, increased likelihood of ICU admission, and a 200% greater 30-day readmission rate. A tremendously costly issue in the U.S., malnutrition is estimated to represent a roughly \$157 billion annual burden on the healthcare system.

Largely misunderstood as a condition featuring extremely undernourished and emaciated patients, malnutrition actually refers to the deficient, excessive, or imbalanced consumption of nutrients needed to maintain healthy bodily tissues and organ functionality. Micronutrient represents a particularly form of “hidden hunger,” where afflicted individuals consume sufficient calories but fail to ingest essential vitamins and minerals to achieve full physiological potential. Malnutrition represents a particularly severe condition for babies and children due to the period of intense physical and cognitive development necessitating sufficient nutrition. Elderly populations similarly pose high risks for malnutrition and related complications.

Diagnosis of malnutrition requires physician recognition of a variety of behaviors and symptoms including rashes, changes in pigmentation, thin hair, bleeding gums, night blindness, increased light sensitivity, decreased activity, and more. A national push has begun for educating healthcare providers on recognizing these symptoms and making adequate diagnoses. This project intends to develop an application (yet to be named) for assisting providers in the process of diagnosing malnutrition by providing a mobile resource for rapid access to clinical characteristics, ICD-10 codes, and treatment plans. The application intends to prompt physicians to engage in screening for all admitted patients, providing a rapid workflow of diagnosis, treatment plan development, and discharge planning.

Initial plans for the application include equipping Vanderbilt University Medical Center physicians and nurses with the completed app for the purposes of improving malnutrition screening and assessing app effectiveness in increasing diagnostic accuracy.

Basic Functional Description and Application Requirements

1. The *Provider* is the primary user of the mobile application. A *Provider* is represented in the app by a unit of data containing identifying information including a full name and title (e.g. physician).
2. The app will provide the *Provider* user with appropriate notifications during expected shift hours with reminders to consult the application for diagnostic assistance. These reminders will contain brief snippets of information advertising the growing medical issue posed by malnutrition and adverse outcomes for undiagnosed patients as a means of encouraging application use. These notifications can be disabled and dismissed by the user.
3. The *Provider* can customize frequency of application notifications and set times for notification delivery. Good times would be during a huddle pre-shift.
4. When the application is opened, the user will be provided with a rapid workflow of diagnostic aid separated into “Signs and Symptoms,” “Diagnosis & ICD-10 Codes,” and “Treatment Options.” While the user will be able to initiate the workflow from the home screen of the application, the user will also be able to access these discrete steps from this menu.
5. “Signs and Symptoms” screen will be based on an interactive graphic of a body. Selecting key body areas will open another screen detailing physical symptoms for observation and options for physical examination (e.g. skin press test). Additionally charts will be accessible detailing other symptoms by category (e.g. activity level) and weight and BMI guidelines.
6. Once symptoms are diagnosed on a patient, a note should be made within the app for that particular workflow (patient) and be sent to a final note to be submitted to the electronic record.
7. “Diagnosis & ICD-10 Codes” screen will provide the *Provider* with options for diagnosis and allow entry of particular medical characteristics of the patient. An appropriate recommendation for ICD-10 code, corresponding to the particular type of malnutrition, will be displayed. Note that the application is not providing a diagnosis here.
8. “Treatment Options” screen will provide the *Provider* with options for nutrition-based treatment plans for the patient based on particular medical characteristics of the patient. Additionally, a specific discharge plan will be suggested.
9. Usage of the application will be tracked by the software to assess the level of engagement and type of engagement made by the user, in particular to see which resources are more commonly and readily accessed by the *Provider*. Periods of inactivity may prompt further notification reminders (2).
10. The particular treatment plan identified by the *Provider* should be easily released to the patient (electronic form).
11. The application should interface with the electronic medical record employed at Vanderbilt University Medical Center and be scalable so as to integrate with whichever system employed at other medical centers. Ideally this is so nurses can make records of malnutrition signs and leave a note for the physician to more thoroughly diagnose the patient. The physician should be able to leave a record of a diagnosis and a request for a follow-up with a dietician.

Implementation Considerations

1. What will the user interface look like for the *Provider* to facilitate use? Additionally, how will the application encourage rapid use so that the physician feels comfortable consulting this guide in the context of a patient visit?
2. What will be the notification structure to encourage the *Provider* to frequently consult the application in a consistent manner?
3. How will the “Signs and Symptoms” page will organized? Possibilities include:
 - a. Organization by multiple screens including a body graphic (described in requirements), charts for weight-loss, and symptom charts.
 - b. Rapid quiz format that asks targeted questions encompassing all possible diagnostic information.
4. Are there legal considerations for the application’s functionality? How can we design the application to reduce potential ramifications for physician use?
5. How much information based on application usage should be stored? Should a complete “cycle” of use be the only thing stored (procedure through all stages of the application process? What benefit do we achieve from tracking this sort of usage?
6. Will the application be integrated with myHealthAtVanderbilt servers? How will the data be securely transferred to/from the server? How will the application usage and data integrate with patient electronic medical records?
7. What type of user preferences will be set by the user? How should notification frequency change be modulated by the application and the user?
8. How will prompts be built-in to trigger *Provider* critical thinking in diagnosis?
9. What will the logical structures and processes be behind diagnostic trees? How will the application integrate medical data with inputted information to produce a predicted diagnostic outcome?
 - a. This question also relies on determining how detailed the application will be in allowing the input of information.
 - b. A balance must be struck between rapid use and detail.
10. For the sake of clinical studies, do we wish to include a knowledge pre-test for *Providers* to assess their knowledge of malnutrition diagnosis? We could include post-test functionality as well.
11. How will overall plans for treatment be varied and allow for customization? How will exportation of these plans work?
12. Is there a need for development of a partner application or patient-oriented version of this application?
 - a. This application could feature the same overall structure and allow patient to track their plan of treatment identified by the *Provider*.

Developer Roles

Available positions on this team are:

1. Mobile developer with React Native or iOS/Android
2. Mobile developer with React Native or iOS/Android
3. Mobile developer with React Native or iOS/Android